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Kitamoto et al.

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(54) **BLADE CUTTING DEVICE AND BLADE CUTTING METHOD**

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B21D 37/20 (2006.01)

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CPC ***B21D 53/64*** (2013.01); ***B21D 37/20*** (2013.01); ***B21D 37/205*** (2013.01); ***B21D 43/28*** (2013.01); ***B21D 43/287*** (2013.01)

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CPC B21D 53/64; B21D 37/205; B21D 43/287; B21D 43/24; B21D 53/62; B21D 28/02;
(Continued)

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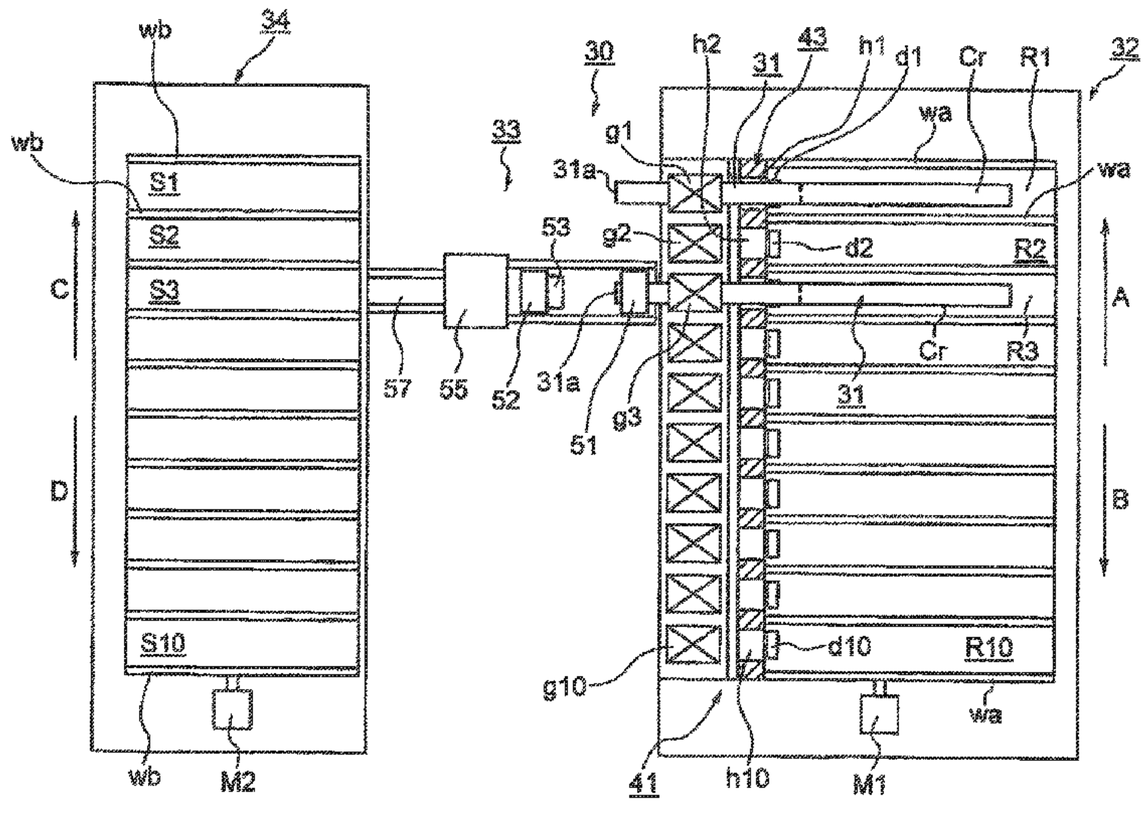
(57) **ABSTRACT**

A blade cutting device includes a material accommodation section having a plurality of accommodation chambers for accommodating the band-shaped materials used to form blades, in such a manner as to be sorted by type; a band-shaped material machining section having a feed unit for feeding a band-shaped material pulled out from a predetermined accommodation chamber and a cutting unit for cutting the band-shaped material into a predetermined length for forming blades; and a control section for causing the material accommodation section to move so as to locate the predetermined accommodation chamber at a position facing the band-shaped material machining section.

6 Claims, 12 Drawing Sheets



(58) **Field of Classification Search**
CPC B21D 37/20; B21D 43/28; B23Q 7/046; B23Q 7/12; B65G 59/04; B65G 65/00
USPC 76/104.1; 83/23, 61, 650, 102–167, 78; 72/338, 363
See application file for complete search history.

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FIG. 1

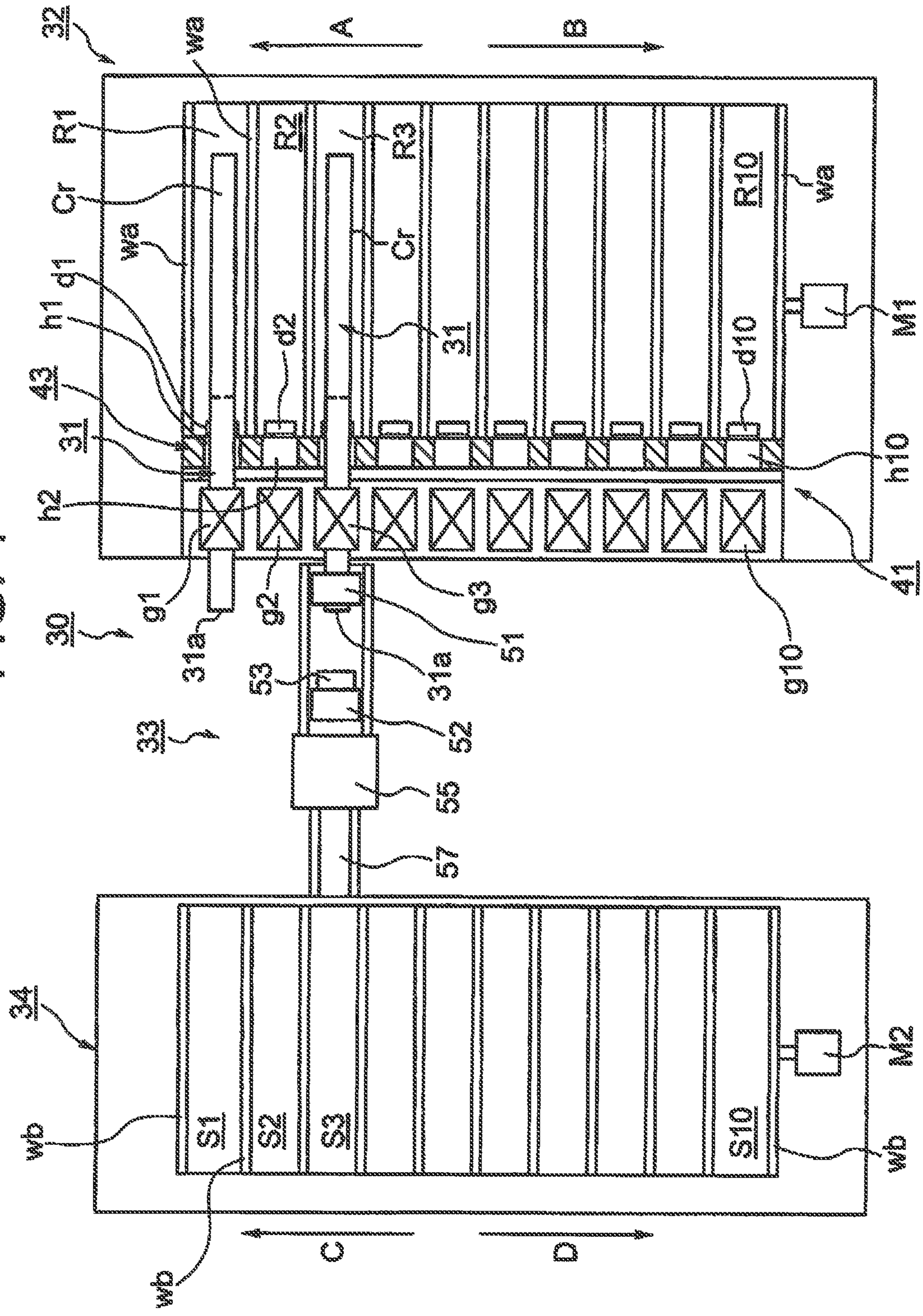

32
wa
A
B
R1
R2
R3
R10
Cr
wa
wa
d1
h1
d2
d10
M1
43
31
31
h2
h10
91
92
93
41
30
31a
31a
53
51
g10
33
52
55
57
34
S1
S2
S3
S10
M2
wb
wb
wb
C
D

FIG. 2

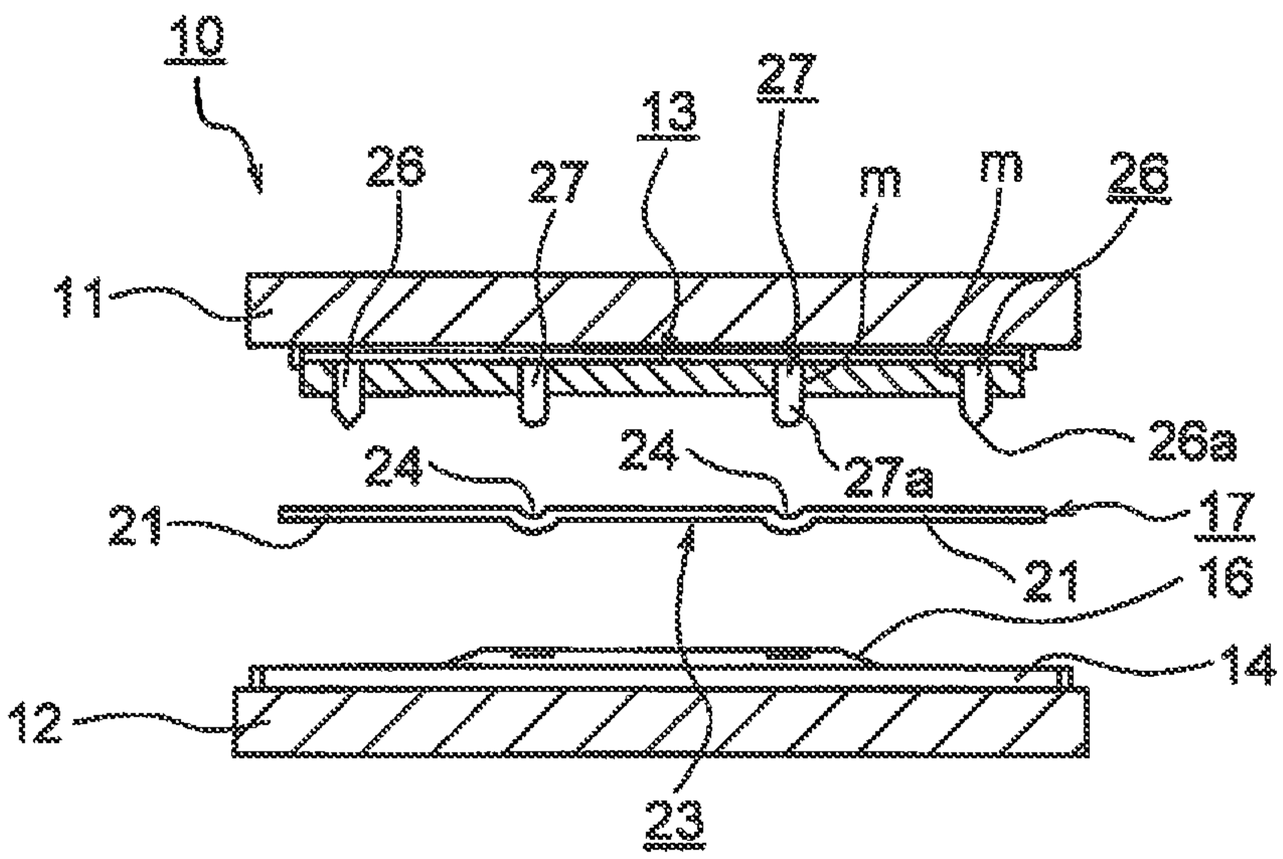


FIG. 3

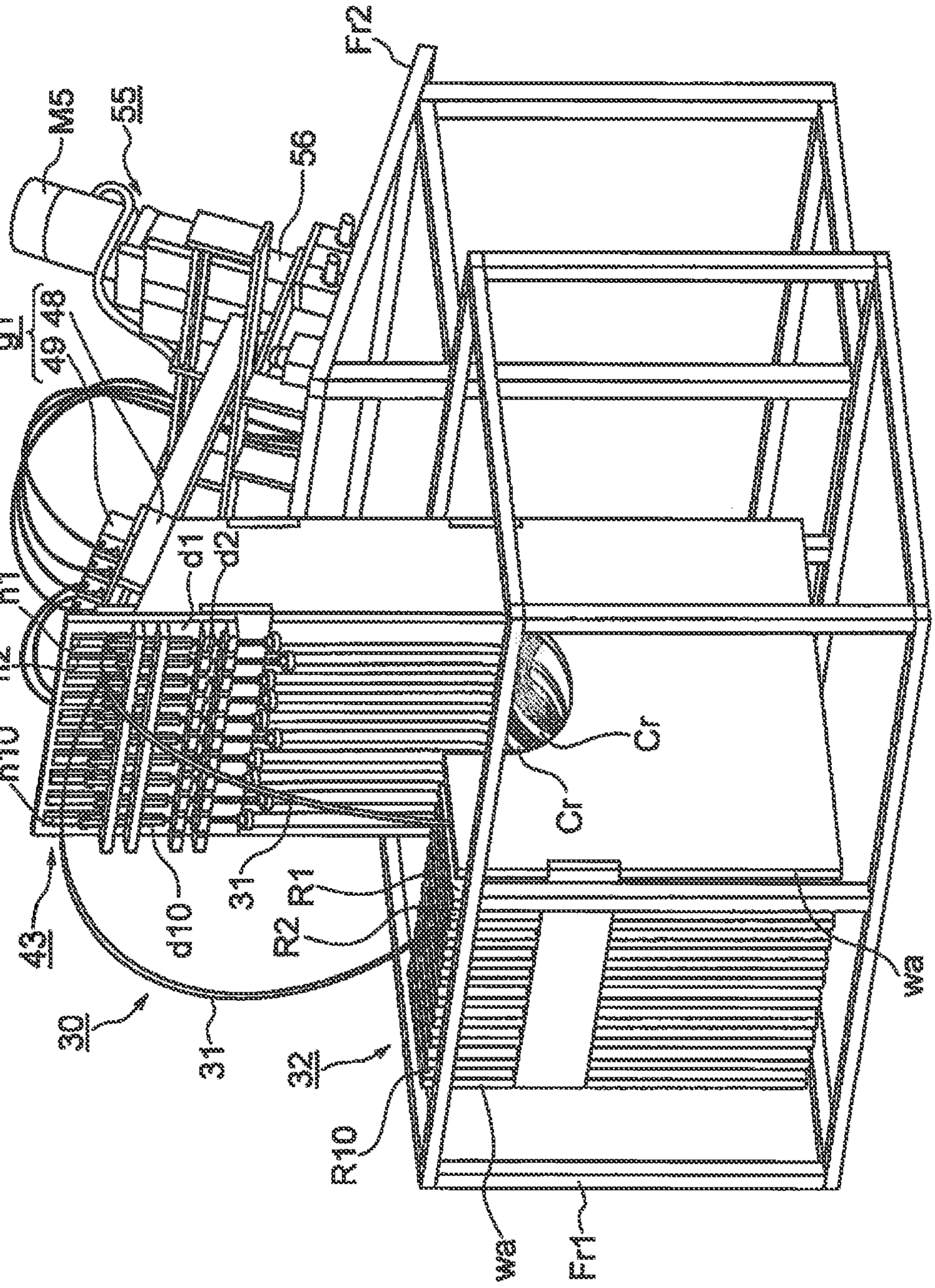

55
45
58
42
48
g1
49
d1
d2
h1
h2
h10
d10
31
R2
R1
43
Cr
We
30
31
32
R10
W8
E11

FIG. 4

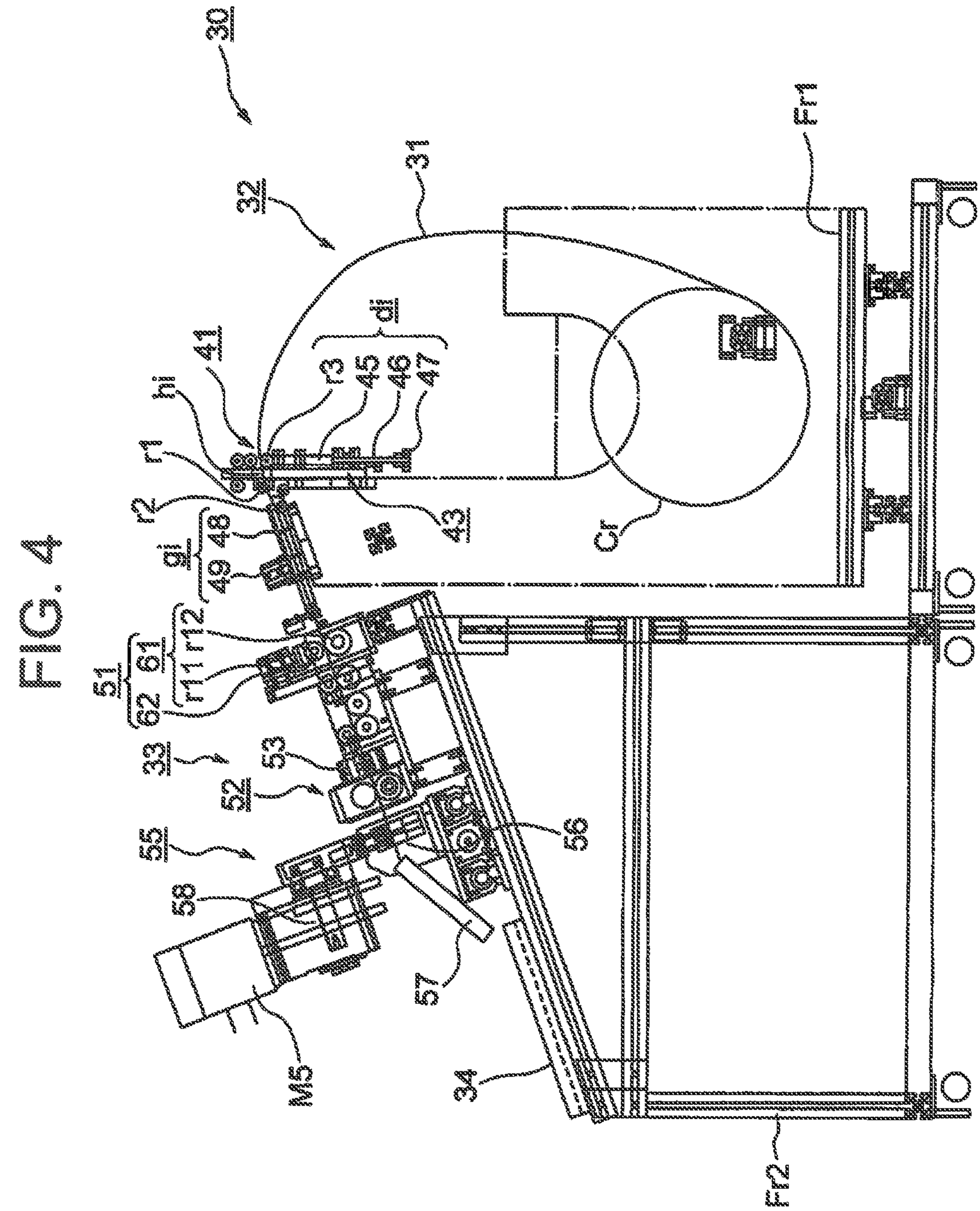

30
31
32
Er1
di
41
hi
43
45
46
47
r1
r2
48
49
hi
r11 r12
51
61
62
33
53
52
56
55
58
57
M5
34
Er2
Cr

FIG. 5

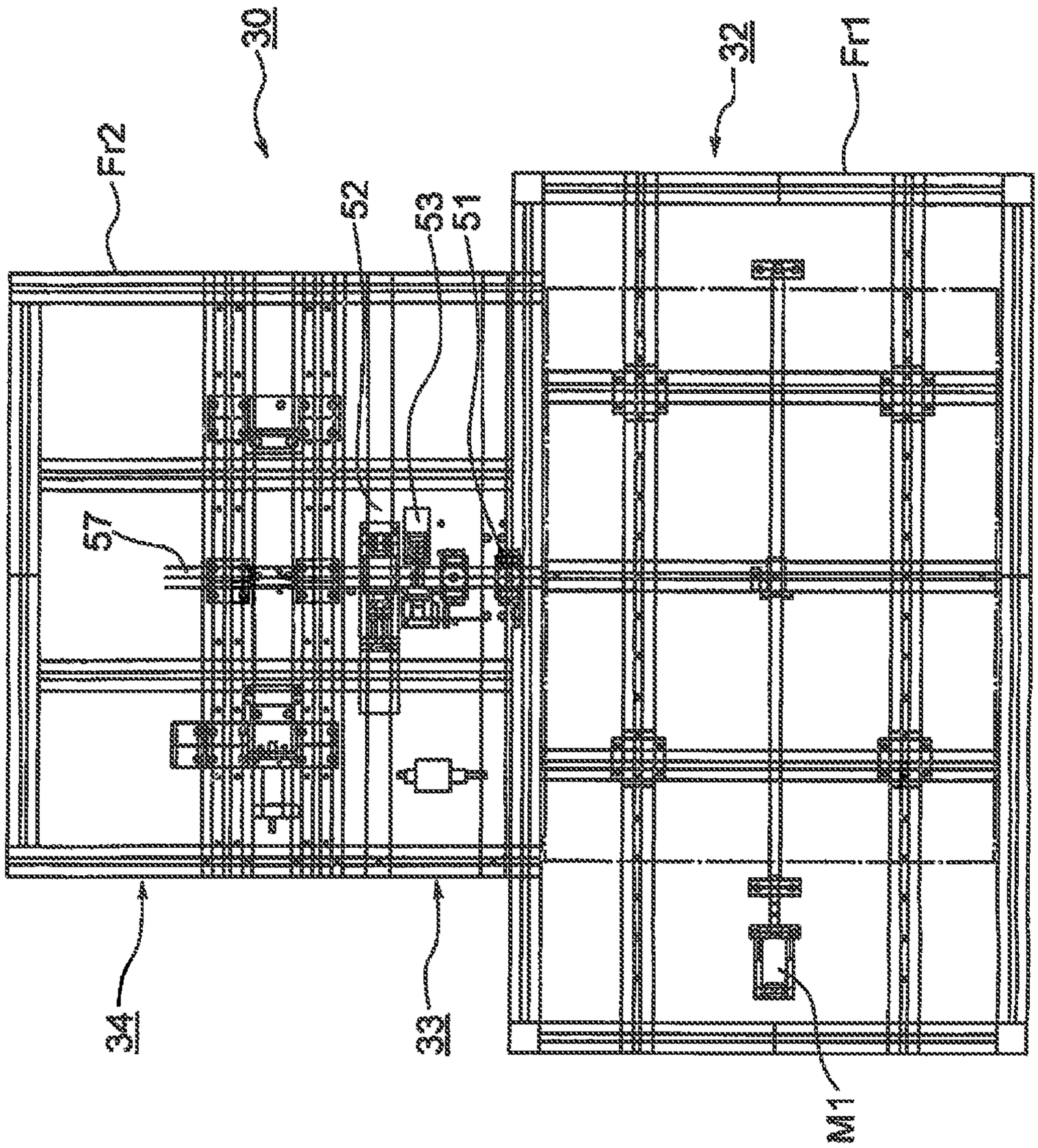


FIG. 6

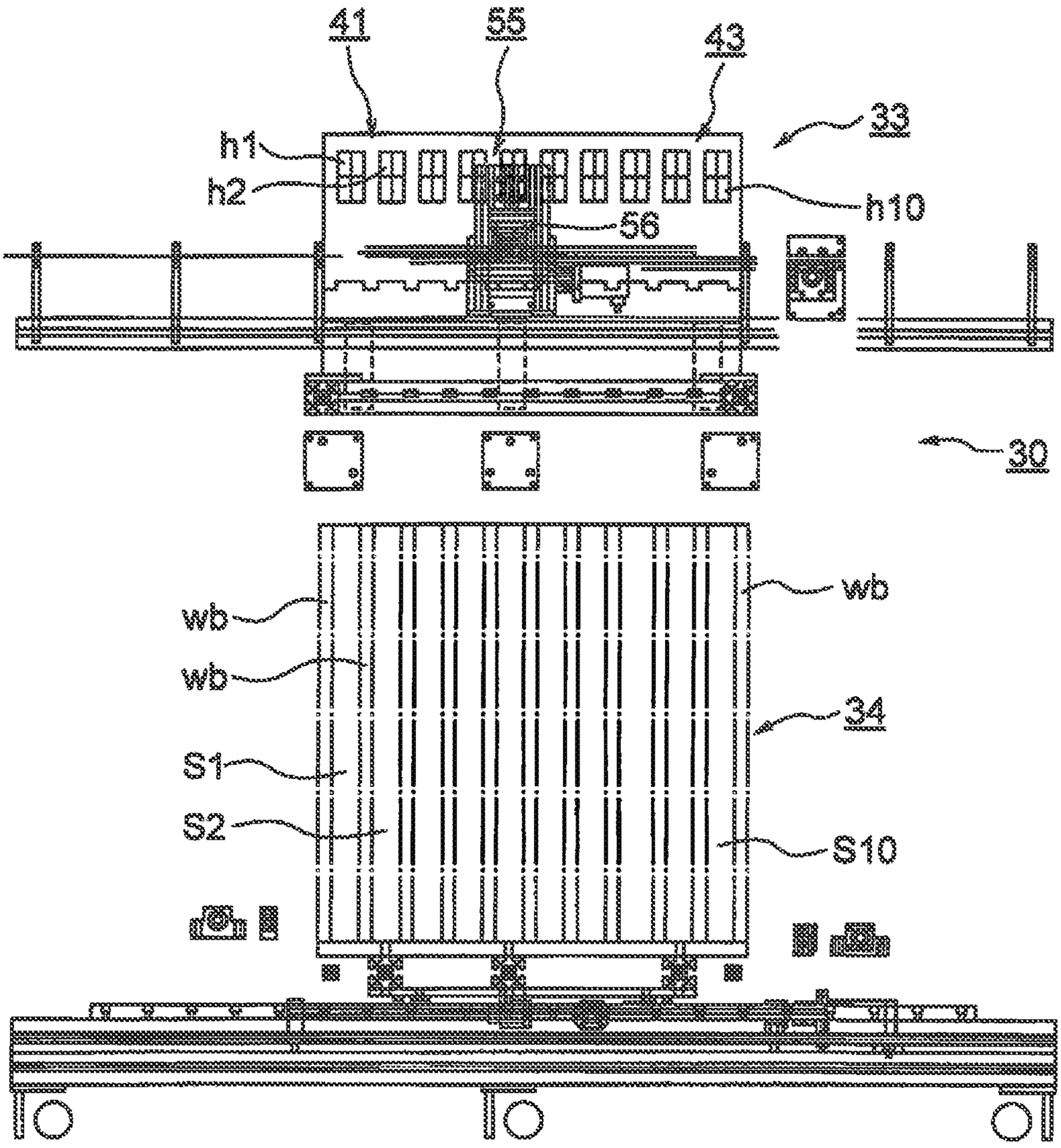


FIG. 7

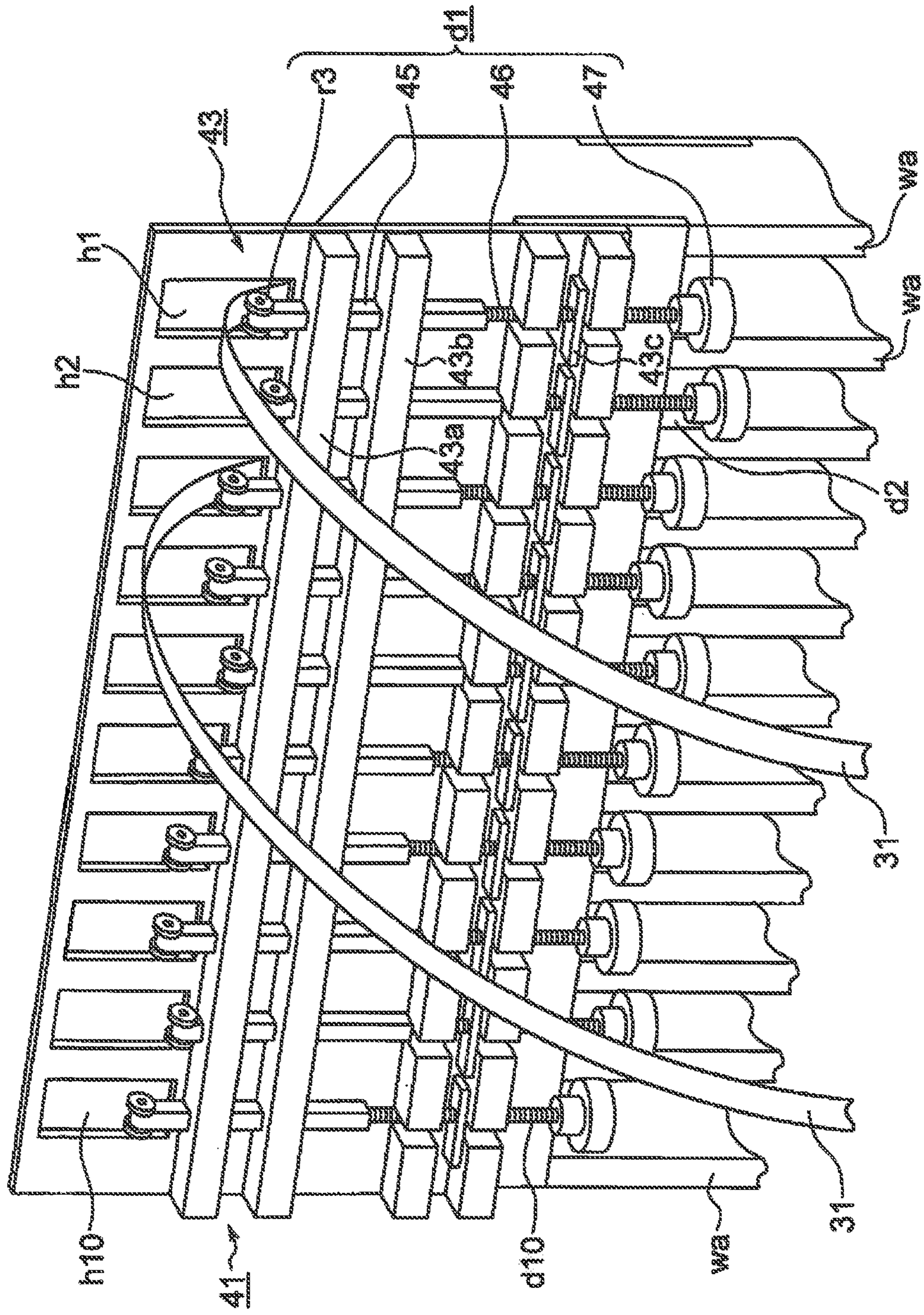


FIG. 8

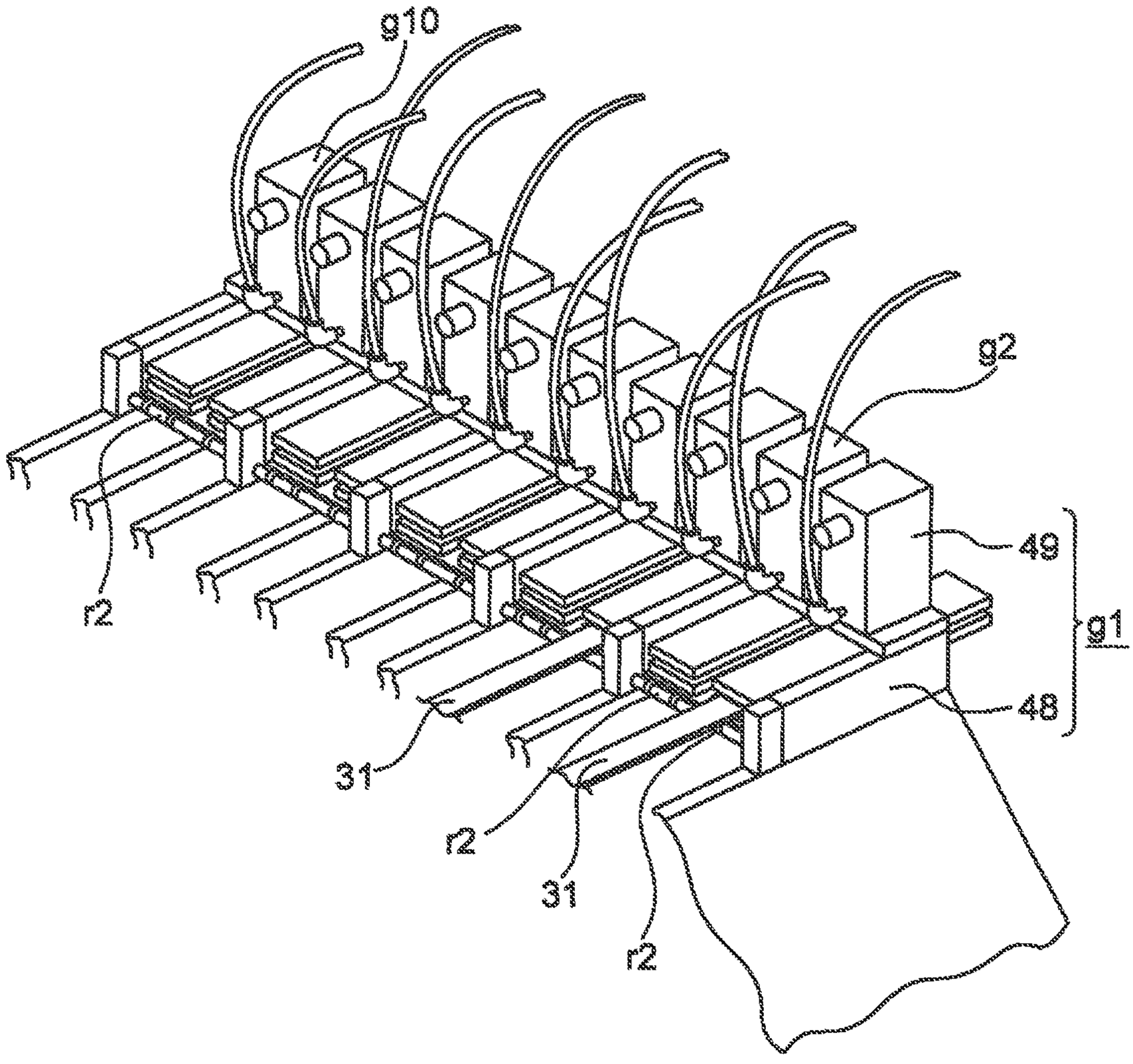


FIG. 9

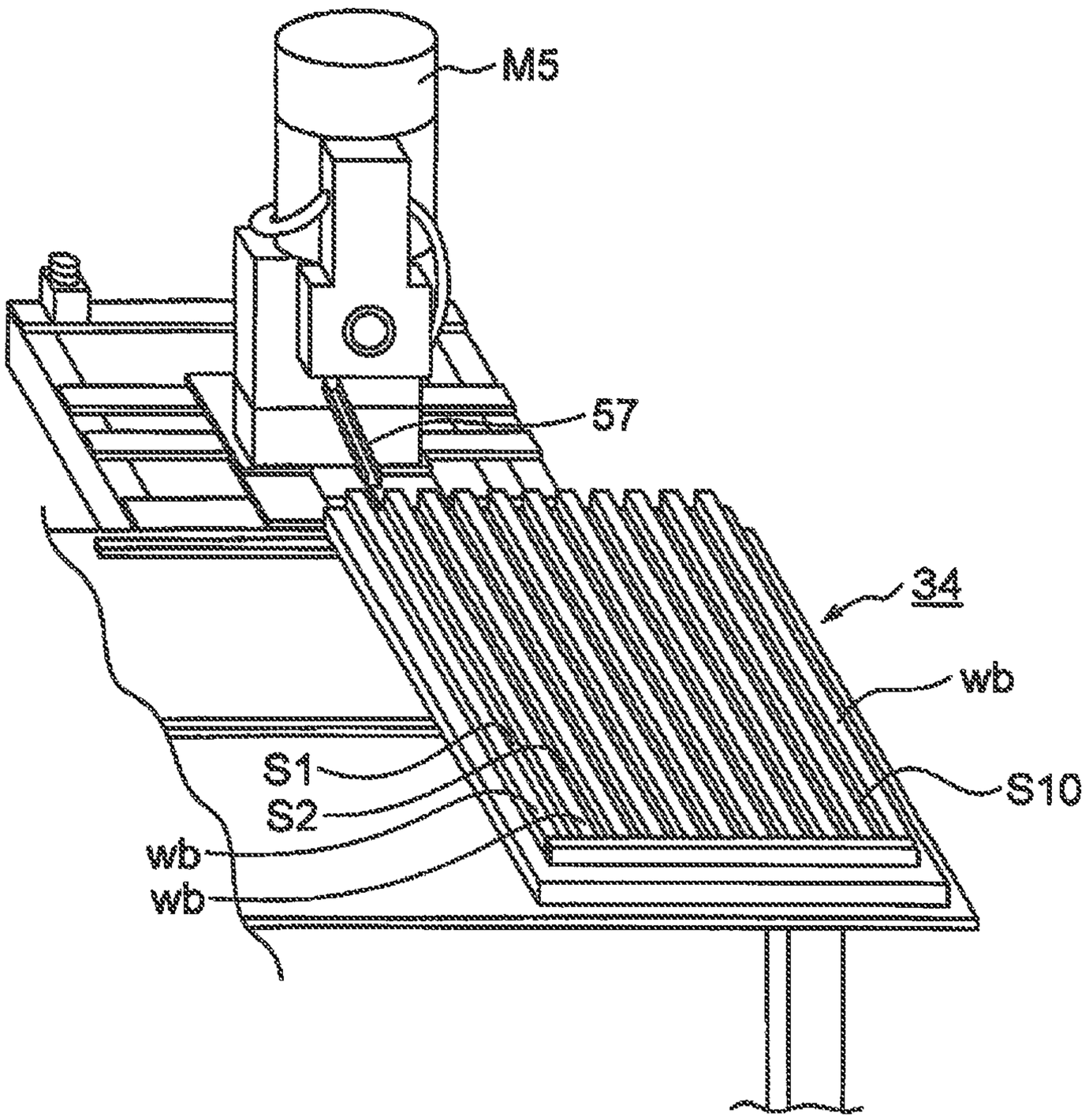
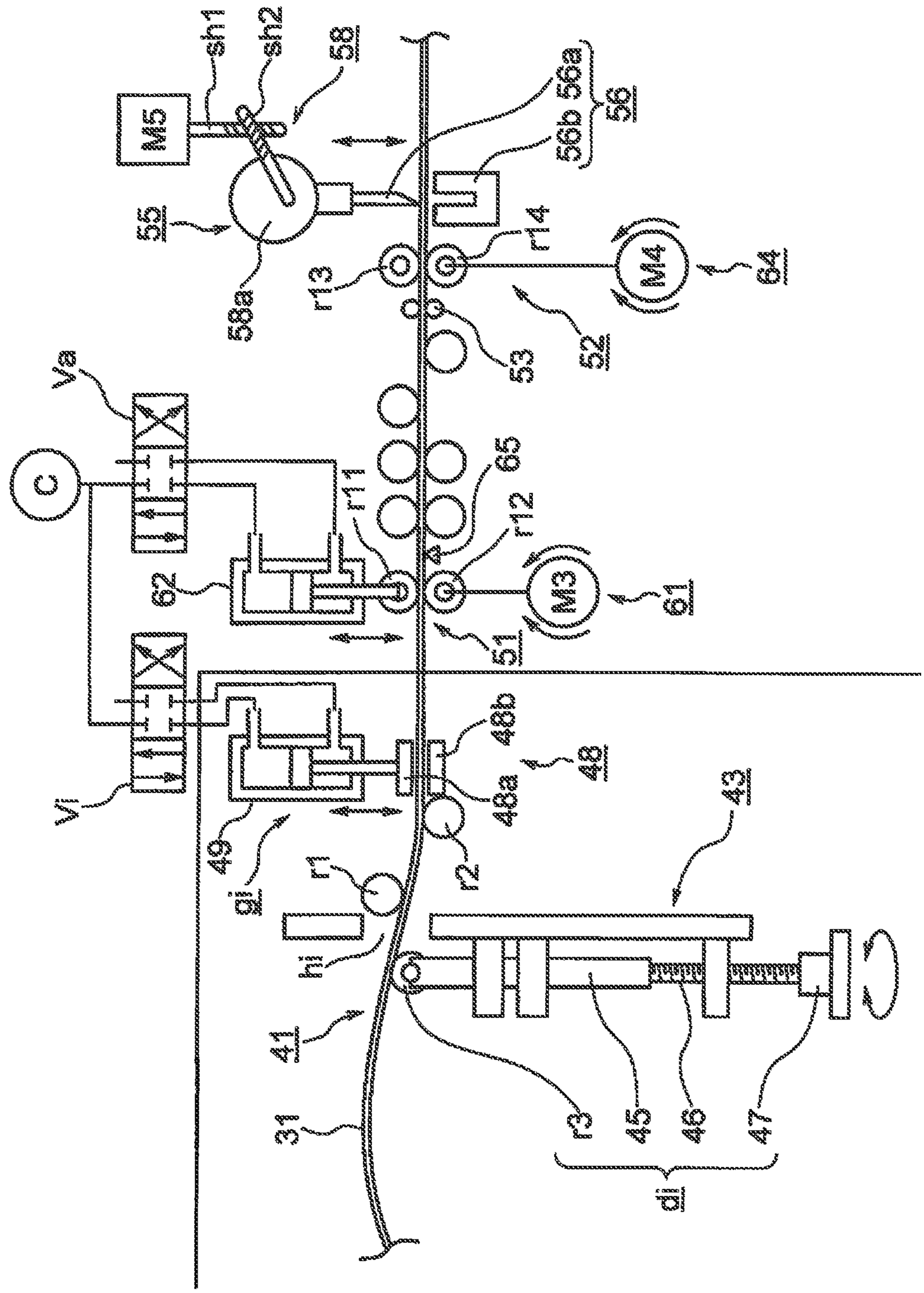


FIG. 10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sh2
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M5
55
56b
56a
56
r14
r13
M4
84
58a
53
52
va
r11
65
r12
62
M3
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48a
48
49
r2
r1
43
hi
41
31
3
45
46
47
di

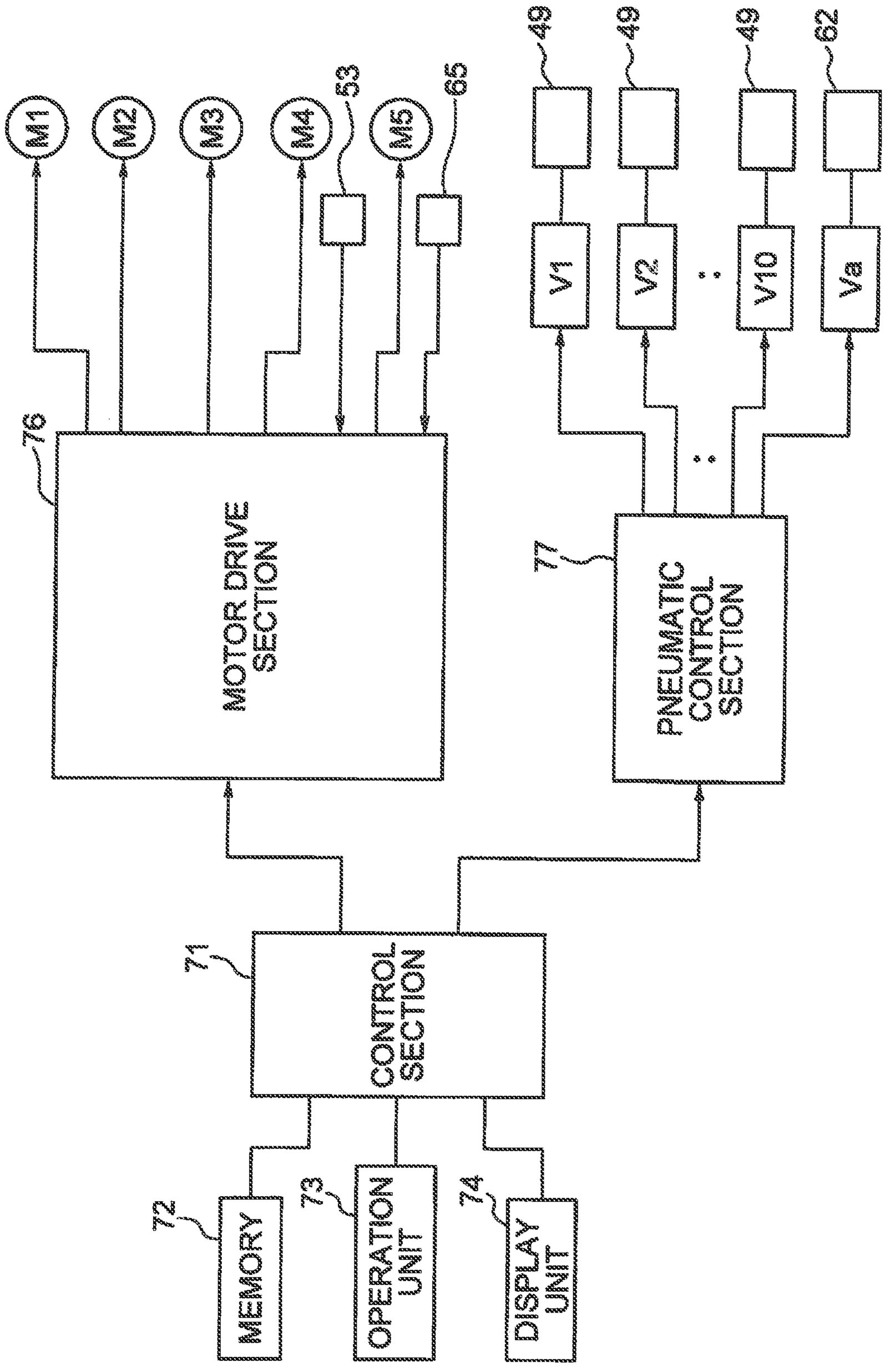
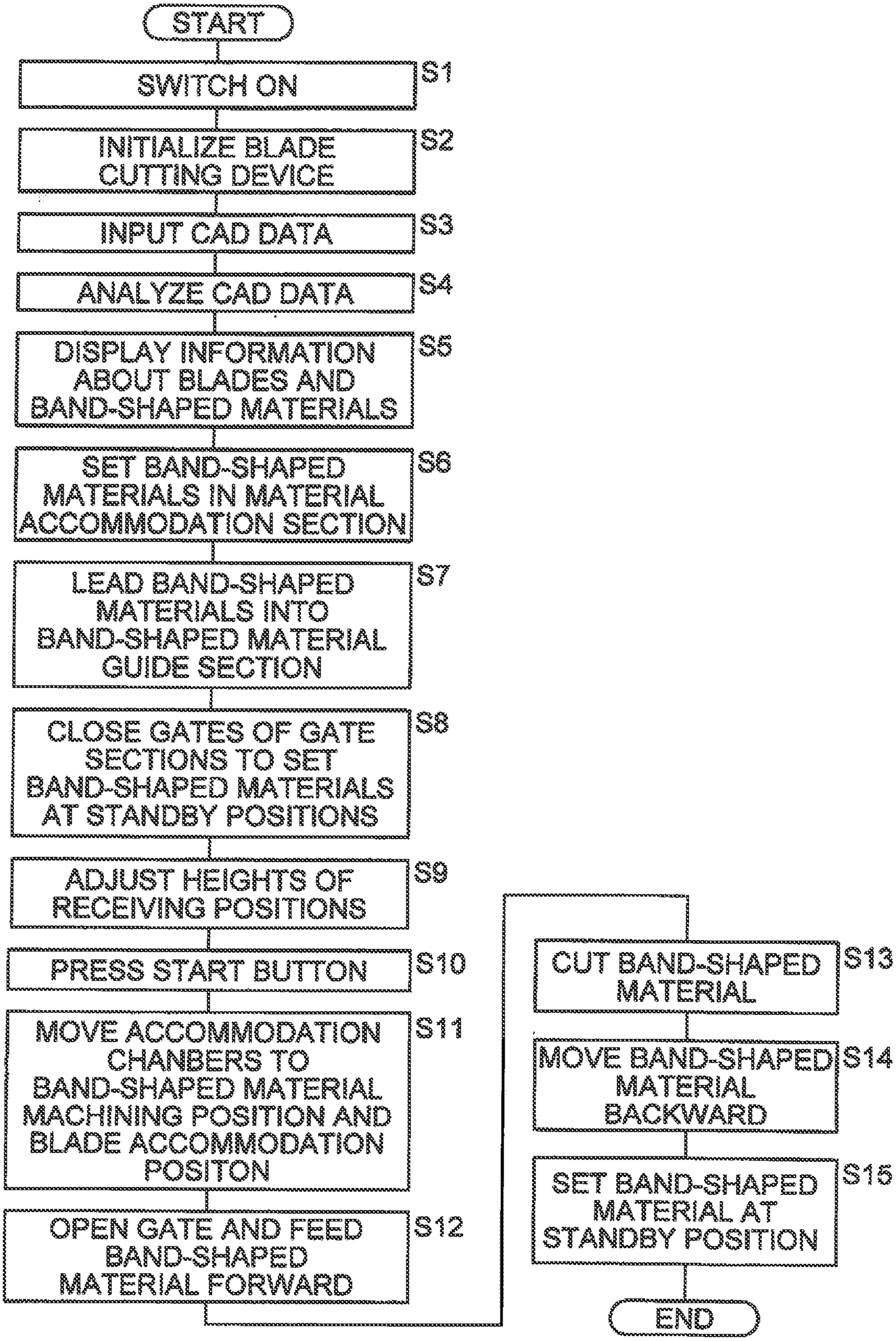

M1
M2
M3
M4
53
M5
65
49
49
49
62
V1
V2
V10
Va
76
MOTOR DRIVE SECTION
77
PNEUMATIC CONTROL SECTION
71
CONTROL SECTION
72
MEMORY
73
OPERATION UNIT
74
DISPLAY UNIT

FIG. 11

FIG. 12


START
SWITCH ON
S1
INITIALIZE BLADE CUTTING DEVICE
S2
INPUT CAD DATA
S3
ANALYZE CAD DATA
S4
DISPLAY INFORMATION ABOUT BLADES AND BAND-SHAPED MATERIALS
S5
SET BAND-SHAPED MATERIALS IN MATERIAL ACCOMMODATION SECTION
S6
LEAD BAND-SHAPED MATERIALS INTO BAND-SHAPED MATERIAL GUIDE SECTION
S7
CLOSE GATES OF GATE SECTIONS TO SET BAND-SHAPED MATERIALS AT STANDBY POSITIONS
S8
ADJUST HEIGHTS OF RECEIVING POSITIONS
S9
PRESS START BUTTON
S10
MOVE ACCOMMODATION CHANBERS TO BAND-SHAPED MATERIAL MACHINING POSITION AND BLADE ACCOMMODATION POSITON
S11
OPEN GATE AND FEED BAND-SHAPED MATERIAL FORWARD
S12
CUT BAND-SHAPED MATERIAL
S13
MOVE BAND-SHAPED MATERIAL BACKWARD
S14
SET BAND-SHAPED MATERIAL AT STANDBY POSITION
S15
END

BLADE CUTTING DEVICE AND BLADE CUTTING METHOD

TECHNICAL FIELD

The present invention relates to a blade cutting device and a blade cutting method.

BACKGROUND ART

Conventionally, a container formed of a sheet material such as paperboard, corrugated cardboard, or the like is formed as follows: a blank having a shape corresponding to the structure of the container is stamped from a sheet material by a stamping machine, and the blank is bent into a predetermined shape.

The stamping machine includes an upper platen and a lower platen; a stamping die is attached to the upper platen, and a cutting plate is attached to the lower platen; a sheet material is placed on the cutting plate; and the upper platen is lowered and pressed against the lower platen, thereby forming a blank from the sheet material and forming ruled lines for bending on the blank.

Thus, the stamping die has grooves in a predetermined pattern; various stamping blades for cutting a sheet material into a blank, and various ruling blades for forming ruled lines for bending are embedded in the grooves; and the stamping blades have sharp edges formed at their lower ends, and the ruling blades have round edges formed at their lower ends.

Meanwhile, a blade cutting device is provided for forming the stamping blades and the ruling blades. In the blade cutting device, graphic data indicative of the shapes and dimensions of the stamping blades and the ruling blades are extracted from CAD data designed for stamping by a stamping machine, and, on the basis of the graphic data, band-shaped materials of metal are cut into the stamping blades and the ruling blades (see, for example, Patent Document 1).

PRIOR ART DOCUMENT

Patent Document

Patent Document 1: Japanese Patent Publication (kokoku) No. H07-36934

SUMMARY OF THE INVENTION

Problem to be Solved by the Invention

However, according to the above conventional blade cutting device, the stamping blades and the ruling blades must be formed one by one by cutting a band-shaped material specified in graphic data into a blade having dimensions specified in the graphic data; thus, the work of cutting the band-shaped materials is troublesome.

In the case of a blank having a complex shape, a blank having complex ruled lines formed thereon, or a like blank, the shape of grooves formed in the stamping die becomes complex, and the number of stamping blades and ruling blades embedded in the grooves increases. Therefore, not only does the number of types of stamping blades and ruling blade increase, but also the number of types of band-shaped materials increases.

Therefore, the work of selecting band-shaped materials for forming the stamping blades and the ruling blades from a large number of types of band-shaped materials becomes complicated, potentially resulting in a failure to accurately form the stamping blades and the ruling blades.

In such a case, proper embedment of the stamping blades and the ruling blades in the grooves of the stamping die fails, resulting in a failure to accurately form a blank.

The present invention has been conceived to solve the above problem involved in the conventional blade cutting device, and an object of the present invention is to provide a blade cutting device and a blade cutting method capable of simplifying the work of cutting band-shaped materials, and accurately forming blades.

Means for Solving the Problem

A blade cutting device of the present invention comprises: a material accommodation section comprising a plurality of accommodation chambers for respectively accommodating different types of band-shaped materials used to form blades; a band-shaped material machining section comprising a feed unit for feeding a band-shaped material pulled out from a predetermined one of the plurality of accommodation chambers and a cutting unit for cutting the fed band-shaped material into a predetermined length for forming blades; and a control section for causing the material accommodation section to move so as to locate the predetermined accommodation chamber of the material accommodation section at a position facing the band-shaped material machining section.

Effects of the Invention

According to the present invention, the blade cutting device comprises: a material accommodation section comprising a plurality of accommodation chambers for respectively accommodating different types of band-shaped materials used to form blades; a band-shaped material machining section comprising a feed unit for feeding a band-shaped material pulled out from a predetermined one of the plurality of accommodation chambers and a cutting unit for cutting the fed band-shaped material into a predetermined length for forming blades; and a control section for causing the material accommodation section to move so as to locate the predetermined accommodation chamber of the material accommodation section at a position facing the band-shaped material machining section.

In this case, different types of band-shaped materials used to form blades are respectively set in a plurality of the accommodation chambers of the material accommodation section; a predetermined one of the plurality of accommodation chambers is located at a position facing the band-shaped material machining section; a band-shaped material pulled out from the predetermined accommodation chamber is fed by the feed unit; and the cutting unit cuts the band-shaped material into a predetermined length for forming blades; therefore, the work of selecting a band-shaped material from a large number of types of band-shaped materials for forming blades can be simplified, and the blade can be formed accurately.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** Conceptual view of a blade cutting device in an embodiment of the present invention.

FIG. **2** Conceptual view of a stamping machine.

FIG. **3** Perspective view of the blade cutting device in the embodiment of the present invention.

FIG. **4** Side view of the blade cutting device in the embodiment of the present invention.

FIG. **5** Plan view of the blade cutting device in the embodiment of the present invention.

FIG. **6** Rear view of the blade cutting device in the embodiment of the present invention.

FIG. **7** Perspective view of a band-shaped material guide section in the embodiment of the present invention.

FIG. **8** Perspective view of essential portions of the band-shaped material guide section in the embodiment of the present invention.

FIG. **9** Perspective view of a blade accommodation section in the embodiment of the present invention.

FIG. **10** Mechanism map of the blade cutting device in the embodiment of the present invention.

FIG. **11** Control block diagram of the blade cutting device in the embodiment of the present invention.

FIG. **12** Flowchart showing the operation of the blade cutting device in the embodiment of the present invention.

MODES FOR CARRYING OUT THE INVENTION

An embodiment of the present invention will next be described with reference to the drawings.

FIG. **2** is a conceptual view of a stamping machine.

In FIG. **2**, **10** denotes a stamping machine; **11** denotes an upper platen; **12** denotes a lower platen; **13** denotes a stamping die attached to the upper platen **11**; **14** denotes a cutting plate attached to the lower platen **12**; and **16** denotes a face plate attached to the cutting plate **14**.

A sheet material **17** such as paperboard, corrugated cardboard, or the like is placed on the face plate **16**; the upper platen **11** is lowered and pressed against the lower platen **12**, thereby stamping a blank **23** from the sheet material **17** along cutting lines **21** and forming ruled lines **24** for bending on the blank **23**.

Thus, the stamping die **13** has grooves m formed therein in a predetermined pattern; stamping blades **26** serving as various first blades for stamping a blank from the sheet material **17** and ruling blades **27** serving as various second blades for forming the ruled lines **24** are embedded in the grooves m; and the stamping blades **26** have sharp edges **26***a* formed at lower ends thereof, and the ruling blades **27** have round edges **27***a* formed at lower ends thereof.

Incidentally, the stamping blades **26** and the ruling blades **27** are formed by cutting band-shaped materials of metal into predetermined lengths by use of a blade cutting device. In the case of the blank **23** having a complex shape, the blank **23** having the complex ruled lines **24**, or a like blank, the shape of the grooves m formed in the stamping die **13** becomes complex, and the number of the stamping blades **26** and the ruling blades **27** increases, resulting in not only an increase in the number of types of the stamping blades **26** and the ruling blades **27**, but also an increase in the number of types of band-shaped materials.

Accordingly, in the blade cutting device, the work of selecting band-shaped materials for forming the stamping blades **26** and the ruling blades **27** from a large number of types of band-shaped materials becomes complicated, potentially resulting in a failure to accurately form the stamping blades **26** and the ruling blades **27**.

Thus, there will be described a blade cutting device of the present invention capable of simplifying the work of selecting blade-shaped materials and accurately forming the stamping blades **26** and the ruling blades **27**.

FIG. **1** is a conceptual view of a blade cutting device in an embodiment of the present invention; FIG. **3** is a perspective view of the blade cutting device in the embodiment of the present invention; FIG. **4** is a side view of the blade cutting device in the embodiment of the present invention; FIG. **5** is a plan view of the blade cutting device in the embodiment of the present invention; FIG. **6** is a rear view of the blade cutting device in the embodiment of the present invention; FIG. **7** is a perspective view of a band-shaped material guide section in the embodiment of the present invention; FIG. **8** is a perspective view of essential portions of the band-shaped material guide section in the embodiment of the present invention; FIG. **9** is a perspective view of a blade accommodation section in the embodiment of the present invention; and FIG. **10** is a mechanism map of the blade cutting device in the embodiment of the present invention.

In the drawings, **30** denotes a blade cutting device; **31** denotes a band-shaped material used to form stamping blades **26** (FIG. **2**), ruling blades **27**, etc.; **32** denotes a material accommodation section adapted to accommodate the band-shaped materials **31** and disposed in such a manner as to be movable in directions of arrows A and B in relation to a frame Fr**1**; **33** denotes a band-shaped material machining section fixed to a frame Fr**2** and adapted to cut the band-shaped materials **31** into predetermined lengths to form blades; **34** denotes a blade accommodation section adapted to accommodate blades formed through cutting in the band-shaped material machining section **33**, and disposed in such a manner as to be movable in directions of arrows C and D in relation to the frame Fr**2**; M**1** denotes a motor serving as a drive section for moving the material accommodation section **32** in the directions of arrows A and B; and M**2** denotes a motor serving as a drive section for moving the blade accommodation section **34** in the directions of arrows C and D. The motors M**1** and M**2** are synchronously driven; when the motors M**1** and M**2** are driven in the positive direction, the material accommodation section **32** is moved in the direction of arrow A, and the blade accommodation section **34** is moved in the direction of arrow C; and when the motors M**1** and M**2** are driven in the reverse direction, the material accommodation section **32** is moved in the direction of arrow B, and the blade accommodation section **34** is moved in the direction of arrow D.

The material accommodation section **32** includes a plurality of, 11 in the present embodiment, "U"-shaped partition walls wa standing in parallel with one another, and the partition walls wa define a plurality of, 10 in the present embodiment, accommodation chambers Ri (i=1, 2, . . . , 10). The accommodation chambers Ri respectively accommodate different types of rolled band-shaped materials **31**; i.e., rolls (coils) Cr.

Incidentally, since the band-shaped materials **31** are accommodated in the material accommodation section **32** in the form of rolls Cr, the band-shaped materials **31** pulled out from the material accommodation section **32** are curled. Thus, the present embodiment includes a band-shaped material guide section **41** which is disposed at an end portion toward the band-shaped material machining section **33** of the material accommodation section **32**, receives the band-shaped materials **31** pulled out from the accommodation chambers Ri, feeds and guides the band-shaped materials **31** to the band-shaped material machining section **33**, and uncurls the band-shaped materials **31** in the course of feed.

The band-shaped material guide section **41** includes: a reception plate **43** extending in the width direction of the blade cutting device **30** and having a plurality of, 10 in the

present embodiment, holes hi (i=1, 2, . . . , 10) formed therein in parallel, serving as reception ports, and corresponding to the accommodation chambers Ri; a plurality of, 10 in the present embodiment, position adjusting sections di (i=1, 2, . . . , 10) disposed on the upstream side of the reception plate **43** with respect to the feed direction of the band-shaped materials **31** in such a manner as to face the respective holes hi and in a vertically movable manner in relation to the reception plate **43**, and adapted to adjust the positions of receiving the band-shaped materials **31** for the band-shaped material guide section **41**; 10 rollers r**1** disposed rotatably in such a manner as to correspond to the holes hi on the downstream side of the reception plate **43** with respect to the feed direction of the band-shaped materials **31**, and serving as pressing members for pressing the band-shaped materials **31** from above so as to direct downward the feed direction of the band-shaped materials **31**; 10 rollers r**2** disposed rotatably in such a manner as to correspond to the rollers r**1** on the downstream side of the rollers r**1** with respect to the feed direction of the band-shaped materials **31**, and serving as first support members for pressing the band-shaped materials **31** from underneath so as to support the band-shaped materials **31**; and a plurality of, 10 in the present embodiment, gate sections gi (i=1, 2, . . . , 10) disposed adjacent to the rollers r**2** in such a manner as to correspond to the accommodation chambers Ri and adapted to set the band-shaped materials **31** at standby positions and to guide the band-shaped materials **31** to the band-shaped material machining section **33**.

The position adjusting sections di (i=1, 2, . . . , 10) include: bars **45** serving as movement support members disposed in a vertically movable manner in relation to the reception plate **43**; 10 rollers r**3** disposed rotatably at upper ends of the bars **45** and serving as second support members for supporting the band-shaped materials **31** by pressing the band-shaped materials **31** from underneath at predetermined vertical positions; screws **46** serving as position adjusting elements and disposed in contact with lower ends of the bars **45** in such a manner as to be rotatable in relation to the reception plate **43** and vertically movable; and knobs **47** disposed at lower ends of the screws **46** and serving as operating elements. Thus, an operator of the blade cutting device **30** can adjust the positions of the rollers r**3** by turning the knobs **47** for rotating the screws **46** so as to vertically move the bars **45** and the rollers r**3**.

The reception plate **43** has retainer members **43***a* and **43***b* formed in a protruding manner, having holes for allowing the bars **45** extending therethrough, and retaining the bars **45** movably, and retainer members **43***c* formed in a protruding manner, having threaded holes threadingly engaged with the screws **46**, and retaining the screws **46** rotatably and movably.

Incidentally, the rollers r**1** to r**3** are disposed along the feed direction of the band-shaped materials **31**; the rollers r**1** press the band-shaped materials **31** from above while rolling; the rollers r**2** and r**3** press the band-shaped materials **31** from underneath while rolling; accordingly, the band-shaped materials **31** can be uncurled while being fed.

The band-shaped materials **31** differ in intensity of curling, depending on type thereof; for example, material, thickness, width, etc. An operator operates the position adjusting section di so as to move the roller r**3** to a predetermined position corresponding to the intensity of curling; as a result, since the height of a receiving position is adjusted, the band-shaped material **31** can be reliably uncurled in response to the type of the band-shaped material **31**. The rollers r**1** to r**3** constitute an uncurling section for uncurling the band-shaped material **31**. In the present embodiment, of the rollers r**1** to r**3**, the roller r**3** is adjusted in position; however, through adjustment of the position of either one of the rollers r**1** and r**2**, the band-shaped material **31** can be uncurled in response to the type of the band-shaped material **31**.

The gate sections gi set the band-shaped materials **31** at their standby positions located downstream of the rollers r**1** with respect to the feed direction of the band-shaped materials **31** and are adapted to selectively guide the band-shaped material **31** pulled out from the predetermined accommodation chamber Ri to the band-shaped material machining section **33**.

Thus, the gate sections gi include gates **48** for opening/closing feed passages for the band-shaped materials **31**, and air cylinders **49** serving as actuators for driving the gates **48**. The gates **48** each include plates **48***a* and **48***b* serving as a pair of gripping members and disposed in such a manner as to vertically come into contact with and separate from each other. The air cylinders **49** are connected to a compressor C serving as a medium supply through a plurality of, 10 in the present embodiment, selector valves Vi (i=1, 2, . . . , 10) disposed in such a manner as to correspond to the gate sections gi, and drive the gates **48** through reception of compressed air serving as working medium and sent from the compressor C to thereby vertically move the plates **48***a*.

When the plates **48***a* are moved to upper positions and separated from the plates **48***b*, the feed passages for the band-shaped materials **31** are opened so as to allow feed of the band-shaped materials **31**. When the plates **48***a* are moved to lower positions and brought in contact with the plates **48***b*, the feed passages for the band-shaped materials **31** are closed, and the band-shaped materials **31** are gripped between the plates **48***a* and **48***b* and disabled from being fed. At this time, the band-shaped materials **31** are set at standby positions. Since the band-shaped materials **31** set at standby positions are gripped between the plates **48***a* and **48***b*, there can be prevented shifting of the band-shaped materials **31** from the standby positions, which could otherwise result from vibration generated in the blade cutting device **30**, deadweight of the band-shaped materials **31**, and the like.

The band-shaped material machining section **33** includes: a first feed unit **51** disposed in such a manner as to face one of the gate sections gi at an upstream end with respect to the feed direction of the band-shaped material **31** and adapted to feed one band-shaped material **31** pulled out from a predetermined accommodation chamber Ri and selectively guided by a relevant gate section gi; a second feed unit **52** disposed downstream of the first feed unit **51** with respect to the feed direction of the band-shaped material **31** and adapted to feed the band-shaped material **31**; an encoder **53** disposed adjacent to the second feed unit **52** between the first and second feed units **51** and **52** and serving as a feed amount detection section for detecting the amount of feed of the band-shaped material **31**; a cutting unit **55** disposed adjacent to the second feed unit **52** on the downstream side of the second feed unit **52** with respect to the feed direction of the band-shaped material **31** and adapted to cut the band-shaped material **31** into a predetermined length for forming blades; a chute **57** serving as a discharge section for sending a blade formed in the cutting unit **55** to the blade accommodation section **34**; and a band-shaped material sensor **65** disposed adjacent to the first feed unit **51** between the first and second feed units **51** and **52** and serving as a position detector for detecting the position of the band-shaped material **31**.

The first feed unit **51** includes a pinch feeder **61** adapted to feed the band-shaped material **31** by pinching, and an air

cylinder **62** serving as an actuator for driving the pinch feeder **61**. The pinch feeder **61** includes rollers r**11** and r**12** serving as a pair of feed members and disposed rotatably and in such a manner as to vertically come into contact with and separate from each other, and a motor M**3** serving as a feed drive for reversibly rotating one of the rollers r**11** and r**12**, the roller r**12** in the present embodiment. The air cylinder **62** is connected to the compressor C through a selector valve Va and drives the pinch feeder **61** through reception of compressed air from the compressor C so as to vertically move the roller r**11**.

When the roller r**11** is moved to an upper position to thereby be separated from the roller r**12**, the feed passage for the band-shaped material **31** is opened; as a result, the band-shaped material **31** is not fed. When the roller r**11** is moved to a lower position, the feed passage for the band-shaped material **31** is closed; as a result, the band-shaped material **31** is fed. When the motor M**3** is driven in the positive direction, the band-shaped material **31** is moved forward toward the second feed unit **52**, and, when the motor M**3** is driven in the reverse direction, the band-shaped material **31** is moved backward.

When the band-shaped material **31** is set at the standby position in each of the gate sections gi, the plate **48***a* is moved to a lower position so as to grip the band-shaped material **31** between the plates **48***a* and **48***b*, and, in the first feed unit **51**, the roller r**11** is moved to the upper position to thereby open the feed passage for the band-shaped material **31**. At this time, a tip **31***a* of the band-shaped material **31** is slightly protruded toward the second feed unit **52** from the contact position between the rollers r**11** and r**12**.

The second feed unit **52** includes a pinch feeder **64** adapted to feed the band-shaped material **31** by pinching. The pinch feeder **64** includes rollers r**13** and r**14** serving as a pair of feed members and disposed rotatably, and a motor M**4** serving as a feed drive for reversibly rotating one of the rollers r**13** and r**14**, the roller r**13** in the present embodiment.

When the first and second feed units **51** and **52** feed the band-shaped material **31**, the encoder **53** detects the amount of feed of the band-shaped material **31**.

The cutting unit **55** includes: a die **56** for cutting the band-shaped material **31**; a motor M**5** serving as a cutting drive for driving the die **56**; and a motion converter **58** for converting a rotary motion of the motor M**5** to a reciprocating motion. The die **56** includes a male die **56***a* and a female die **56***b*; the motion converter **58** includes a rotation transmission shaft sh**2** threadingly engaged with an output shaft sh**1** of the motor M**5**, and a cam **58***a* rotated by the rotation transmission shaft sh**2**; when the motor M**5** is driven to rotate the output shaft sh**1**, the cam **58***a* is rotated through the rotation transmission shaft sh**2** to thereby vertically move the male die **56***a*. The male die **56***a* moved to an upper position is separated from the female die **56***b*, and the male die **56***a* moved to a lower position enters the female die **56***b* to thereby cut the band-shaped material **31**.

The blade accommodation section **34** includes a plurality of, 11 in the present embodiment, partition walls wb extending and standing in parallel with one another, and the partition walls wb define a plurality of, 10 in the present embodiment, groove-shaped accommodation chambers Si (i=1, 2, . . . , 10). The accommodation chambers Si accommodate blades formed by cutting the band-shaped materials **31** in the cutting unit **55**, in such a manner as to assort the blades by type.

Next, a control device for the blade cutting device **30** will be described.

FIG. **11** is a control block diagram of the blade cutting device in the embodiment of the present invention.

In FIG. **11**, **71** denotes a control section for controlling the entire blade cutting device **30**; **72** denotes a memory serving as a storage; **73** denotes an operation unit composed of an operation panel, etc.; and **74** denotes a display unit composed of a liquid crystal panel, a display, etc. Also, **76** denotes a motor drive section for driving the motors M**1** to M**5**; **53** denotes an encoder; **65** denotes a band-shaped material sensor; and **77** denotes a pneumatic control section for driving the air cylinders **49** and **62** through selective operation of the selector valves Vi and Va.

The encoder **53** is formed of a rotary encoder, includes a pair of rotary elements pinching the band-shaped material **31** (FIG. **1**) therebetween and rotated by friction with the band-shaped material **31** as a result of feed of the band-shaped material **31**, detects the amount of feed of the band-shaped material **31** on the basis of a rotation angle of the rotary elements, and sends a detection signal to the control section **71**.

Incidentally, in the present embodiment, the amount of feed of the band-shaped material **31** is detected on the basis of a rotation angle of the motor M**4**. However, since the band-shaped material **31** is pulled out while the roll Cr is unrolled, in some cases, the band-shaped material **31** may slip and fail to be smoothly fed as a result of imposition of a large load on the motor M**4** in the course of feeding the band-shaped material **31** by the second feed unit **52**. In such a case, the amount of feed of the band-shaped material **31** cannot be detected accurately on the basis of a rotation angle of the motor M**4**; however, in the present embodiment, since the encoder **53** is disposed separately from the motor M**4** and detects the amount of feed of the band-shaped material **31** on the basis of a rotation angle of the rotary elements rotated by friction with the band-shaped material **31**, the amount of feed of the band-shaped material **31** can be detected accurately.

The band-shaped material sensor **65** detects the position of the band-shaped material **31** being fed between the first and second feed units **51** and **52** and sends a detection signal to the control section **71**. In the present embodiment, whether or not the tip **31***a* of the band-shaped material **31** has reached between the rollers r**13** and r**14** of the pinch feeder **64** is judged from a sensor output of the encoder **53**; however, whether or not the tip **31***a* of the band-shaped material **31** has reached between the rollers r**13** and r**14** of the pinch feeder **64** can also be judged on the basis of a detection signal of a band-shaped material sensor disposed adjacent to the second feed unit **52** on the downstream side of the second feed unit **52** with respect to the feed direction of the band-shaped material **31**.

Next, the operation of the blade cutting device **30** will be described.

FIG. **12** is a flowchart showing the operation of the blade cutting device in the embodiment of the present invention.

First, when an operator switches on the blade cutting device **30** (step S**1**), the control section **71** initializes the blade cutting device **30** (step S**2**). At this time, in the band-shaped material guide section **41**, the gates **48** of the gate sections gi are opened to thereby move the plates **48***a* to the upper positions. In the first feed unit **51**, the rollers r**11** and r**12** of the pinch feeder **61** are stopped, and the roller r**11** is moved to the upper position. In the second feed unit **52**, the rollers r**13** and r**14** of the pinch feeder **64** are stopped. In the cutting unit **55**, the male die **56***a* of the die **56** is moved to the upper position.

Next, when the operator operates the operation unit **73** (FIG. **11**) of the blade cutting device **30** so as to input CAD data designed for stamping by the stamping machine **10** (FIG. **2**) to the blade cutting device **30** (step S**3**), the control section **71** reads the CAD data into the memory **72**. Subsequently, the control section **71** reads the CAD data from the memory **72** and analyzes the CAD data (step S**4**) so as to extract graphic data indicative of the shapes and dimensions of blades, calculates, on the basis of the graphic data, the colors, thicknesses, lengths, etc., of blades required in stamping by the stamping machine **10** so as to specify the band-shaped materials **31** required for forming the blades, and lists information about the blades and the band-shaped materials **31** such as the colors, thicknesses, and lengths of the blades, the names of the band-shaped materials **31**, etc., on the display unit **74** (step S**5**).

Then, according to the list displayed on the display unit **74**, the operator sets the rolls Cr of the band-shaped materials **31** in the respective accommodation chambers Ri of the material accommodation section **32** in accordance with the types of the band-shaped materials **31** (step S**6**), pulls out the band-shaped materials **31**, and leads the band-shaped materials **31** into the band-shaped material guide section **41** (step S**7**). At this time, the tips **31***a* of the band-shaped materials **31** are slightly protruded toward the second feed unit **52** from the contact position between the rollers r**11** and r**12** of the first feed unit **51**.

Subsequently, the control section **71** instructs the pneumatic control section **77** to perform switchover on the selector valves Vi for actuating the air cylinders **49** so as to close the gates **48**; i.e., to move the plates **48***a* to the lower positions. As a result, the band-shaped materials **31** are set at the standby positions with their tips **31***a* protruding slightly from the contact position between the rollers r**11** and r**12** (step S**8**).

Next, the operator turns the knobs **47** of the position adjusting sections di for turning the screws **46** so as to vertically move the bars **45** and the rollers r**3** for moving the rollers r**3** to predetermined vertical positions in response to the intensities of curling of the band-shaped materials **31** to thereby adjust heights of receiving positions (step S**9**).

Subsequently, when the operator presses a start button on the operation unit **73** (step S**10**), the control section **71** instructs the motor drive section **76** to drive the motors M**1** and M**2** for moving the material accommodation section **32** in such a manner as to move a predetermined accommodation chamber Ri accommodating the roll Cr of the band-shaped material **31** to a position facing the band-shaped material machining section **33**; i.e., to a band-shaped material machining position, and for moving the blade accommodation section **34** in such a manner as to move a predetermined accommodation chamber Si adapted to accommodate a blade formed by cutting the band-shaped material **31**, to a position facing the band-shaped material machining section **33**; i.e., to a blade accommodation position (step S**11**).

Then, the control section **71** instructs the pneumatic control section **77** to perform switchover on the selector valve Vi for opening the gate **48** of the gate section gi corresponding to the accommodation chamber Ri located at the band-shaped material machining position to thereby move the plate **48***a* to the upper position, and to perform switchover on the selector valve Va for moving the roller r**11** of the first feed unit **51** to the lower position. Also, the control section **71** instructs the motor drive section **76** to drive the motors M**3** and M**4** in the positive direction for rotating the rollers r**11** to r**14**. As a result, the band-shaped material **31** is fed forward by the first and second feed units **51** and **52** (step S**12**).

When the tip **31***a* of the band-shaped material **31** reaches the encoder **53**, the encoder **53** starts to detect the amount of feed of the band-shaped material **31** and sends a detection signal to the control section **71**.

On the basis of the detection signal received from the encoder **53**, the control section **71** judges whether or not the tip **31***a* of the band-shaped material **31** has reached between the rollers r**13** and r**14**. When the control section **71** judges that the tip **31***a* of the band-shaped material **31** has reached between the rollers r**13** and r**14**, the control section **71** instructs the pneumatic control section **77** to perform switchover on the selector valve Va so as to move the roller r**11** to the upper position and instructs the motor drive section **76** to stop driving the motor M**3**. Accordingly, since the pinch feeder **61** does not impose load on the second feed unit **52** while the second feed unit **52** feeds the band-shaped material **31**, the band-shaped material **31** can be stably fed. As a result, a blade can be formed accurately.

The control section **71** obtains the amount of feed of the band-shaped material **31** on the basis of the detection signal from the encoder **53**, and, when the amount of feed becomes equal to the length of a blade to be formed, the control section **71** instructs the motor drive section **76** to drive the motor M**5** so as to cut the band-shaped material **31** by the die **56** (step S**13**).

A blade formed by cutting the band-shaped material **31** is discharged into the accommodation chamber Si located at the blade accommodation position through the chute **57**.

Subsequently, the control section **71** instructs the motor drive section **76** to drive the motors M**3** and M**4** in the reverse direction so as to rotate the rollers r**11** to r**14** in the reverse direction. As a result, the band-shaped material **31** which has undergone cutting is moved backward by the first and second feed units Si and **52** (step S**14**).

When the band-shaped material sensor **65** detects the tip **31***a* of the band-shaped material **31** and sends a detection signal to the control section **71**, the control section **71** instructs the motor drive section **76** to stop driving the motors M**3** and M**4**. Also, the control section **71** instructs the pneumatic control section **77** to perform switchover on the selector valve Vi so as to close the gate **48** of the gate section gi; i.e., to move the plate **48***a* to the lower position, and instructs the pneumatic control section **77** to perform switchover on the selector valve Va so as to move the roller r**11** of the pinch feeder **61** in the first feed unit **51** to the upper position. By this procedure, the band-shaped material **31** is set at the standby position (step S**15**).

In the present embodiment, as shown in FIG. **1**, the rolls Cr of the band-shaped materials **31** are set respectively in the accommodation chambers R**1** and R**3** of the material accommodation section **32**, and the tips **31***a* of the band-shaped materials **31** pulled out from the accommodation chambers R**1** and R**3** are slightly protruded toward the second feed unit **52** from the contact position between the rollers r**11** and r**12** (FIG. **4**) of the first feed unit **51**, whereby the band-shaped materials **31** are set at their standby positions.

When the operator presses the start button on the control section **73** (FIG. **11**), the motors M**1** and M**2** are driven so as to move the accommodation chamber R**3** of the material accommodation section **32** to the band-shaped material machining position, and the accommodation chamber S**3** of the blade accommodation section **34** is moved to the blade accommodation position.

Subsequently, in the band-shaped material guide section **41**, the gate **48** of the gate section g**3** corresponding to the accommodation chamber R**3** located at the band-shaped material machining position is opened to thereby move the plate **48***a* to the upper position. In the band-shaped material machining section **33**, the roller r**11** of the pinch feeder **61** is moved to the lower position, and the motors M**3** and M**4** are driven in the positive direction to thereby rotate the rollers r**11** to r**14**. As a result, the band-shaped material **31** pulled out from the accommodation chamber R**3** is fed forward by the first and second feed units **51** and **52**.

When the tip **31***a* of the band-shaped material **31** reaches the encoder **53**, the encoder **53** starts to detect the amount of feed of the band-shaped material **31**. When the amount of feed of the band-shaped material **31** becomes equal to the length of a blade, the motor M**5** is driven so as to cut the band-shaped material **31**, by the die **56**, into a dimension specified in the graphic data. A blade formed through cutting is discharged into the accommodation chamber S**3** located at the blade accommodation position through the chute **57**.

Subsequently, the motors M**3** and M**4** are driven in the reverse direction to thereby rotate the rollers r**11** to r**14** accordingly, whereby the band-shaped material **31** is moved backward by the first and second feed units **51** and **52**. When the band-shaped material sensor **65** detects the tip **31***a* of the band-shaped material **31**, the motors M**3** and M**4** are stopped to thereby stop the rollers r**11** to r**14**, and the gate **48** of the gate section g**3** is closed, thereby setting the band-shaped material **31** at the standby position.

As mentioned above, in the present embodiment, the band-shaped materials **31** of different types are respectively accommodated in the accommodation chambers Ri of the material accommodation section **32**; a predetermined one of the accommodation chambers Ri is located at the band-shaped material machining position facing the band-shaped material machining section **33**; and the band-shaped material **31** pulled out from the predetermined accommodation chamber is fed by the first and second feed units **51** and **52** and cut into a predetermined length by the cutting unit **55** so as to form a blade.

Therefore, the work of selecting the band-shaped material **31** from a large number of types of the band-shaped materials **31** for forming blades can be simplified, and the blade can be formed accurately.

A predetermined one of the accommodation chambers Si of the blade accommodation section **34** is located at the blade accommodation position facing the band-shaped material machining section **33**, and a blade formed by the cutting unit **55** is discharged into the predetermined accommodation chamber. Therefore, blades of different types corresponding to the band-shaped materials **31** of different types can be accommodated in such a manner as to be sorted by type.

Accordingly, since blades taken from the accommodation chambers Si can be accurately embedded in respective grooves of a stamping die, blanks can be formed accurately.

In the present embodiment, a single band-shaped material machining section **33** is disposed between the material accommodation section **32** and the blade accommodation section **34**. However, a plurality of; for example, two band-shaped material machining sections **33**, can be disposed in parallel between the material accommodation section **32** and the blade accommodation section **34**. In such a case, two of the band-shaped materials **31** received in the band-shaped material guide section **41** are guided to the respective band-shaped material machining sections **33**.

In the present embodiment, the air cylinders **49** and **62** are used as the actuators. However, oil hydraulic cylinders, motors, or the like can be used in place of the air cylinders **49** and **62**.

DESCRIPTION OF REFERENCE NUMERALS

26: stamping blade
27: ruling blade
30: blade cutting device
31: band-shaped material
32: material accommodation section
33: band-shaped material machining section
51, **52**: first and second feed units
55: cutting unit
71: control section
Ri: accommodation chamber

The invention claimed is:

1. A blade cutting device characterized by comprising:

(a) a material accommodation section comprising a plurality of accommodation chambers for respectively accommodating different types of band-shaped materials used to form blades;

(b) a band-shaped material machining section comprising a feed unit for feeding a band-shaped material pulled out from a predetermined one of the plurality of accommodation chambers and a cutting unit for producing formed blades by cutting the fed band-shaped material into a predetermined length;

(c) a blade accommodation section linearly movable relative to the band-shaped material machining section and comprising a plurality of blade accommodation chambers for respectively receiving the formed blades in such a manner as to be sorted by type; and

(d) a control section for controlling the material accommodation section to linearly move so as to locate the predetermined accommodation chamber of the material accommodation section at a position facing the band-shaped material machining section, and for controlling the blade accommodation section to linearly move so as to locate a predetermined one of the blade accommodation chambers at a position facing the band-shaped material machining section, the material accommodation section being moved synchronously with the blade accommodation section to correlate a predetermined accommodation chamber with a predetermined material accommodation chamber.

2. A blade cutting device according to claim **1**, wherein the material accommodation section comprises a band-shaped material guide section for receiving the band-shaped materials pulled out from the accommodation chambers of the material accommodation section and for uncurling the band-shaped materials and for feeding the band-shaped material to the band-shaped material machining section.

3. A blade cutting device according to claim **2**, wherein the band-shaped material guide section comprises uncurling sections disposed in such a manner as to correspond to the accommodation chambers of the material accommodation section and adapted to uncurl the band-shaped materials.

4. A blade cutting device according to claim **3**, wherein the uncurling sections are composed of a plurality of rollers disposed along a feed direction of the band-shaped materials.

5. A blade cutting device according to claim **4**, wherein the band-shaped material guide section comprises position adjusting sections for adjusting the positions of predetermined ones of the plurality of rollers.

6. A blade cutting device according to claim 2, wherein the band-shaped material guide section comprises gate sections disposed in such a manner as to correspond to the accommodation chambers of the material accommodation section and adapted to grip and set the band-shaped materials pulled out from the accommodation chambers at respective standby positions.

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